Survey of TIDE "Lobal Wind" Observations

Mike Liemohn, TIDE Telecon, May 8, 2003

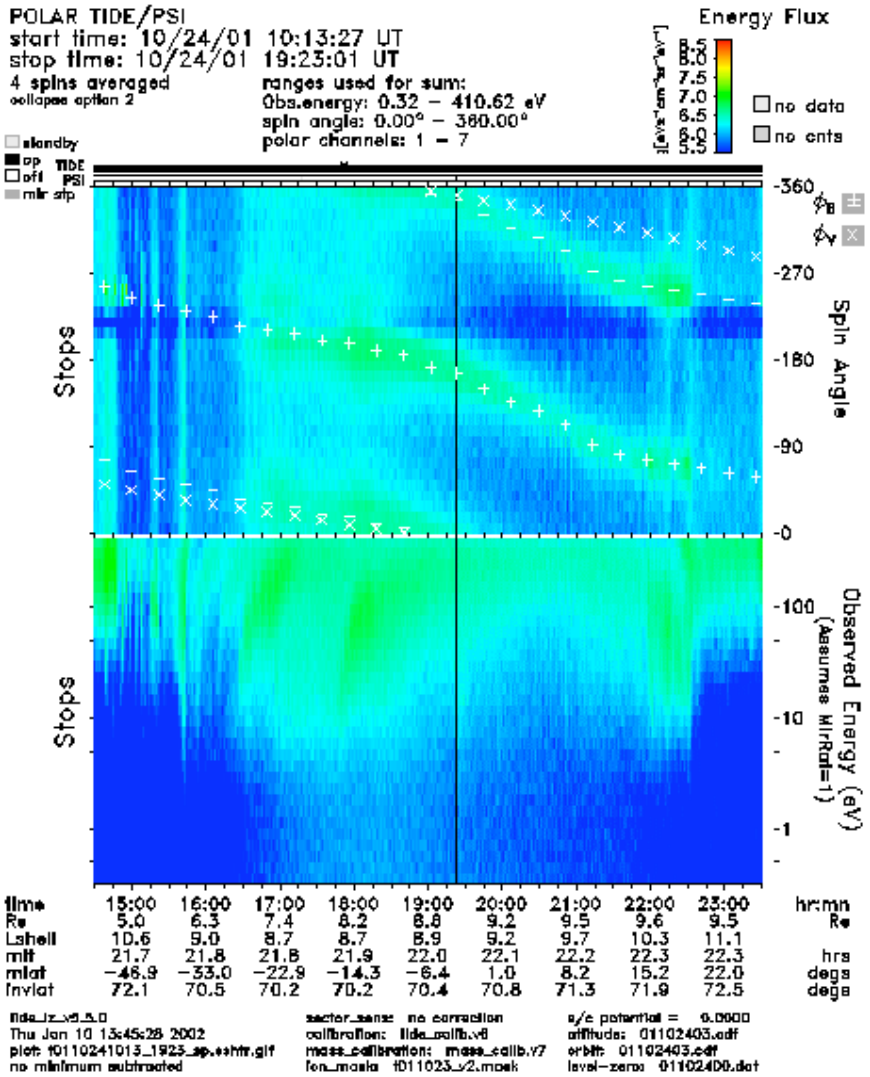
With many thanks to Tom Moore

Lobal Winds: ubiquitous beams of cold plasma in the magnetotail lobes

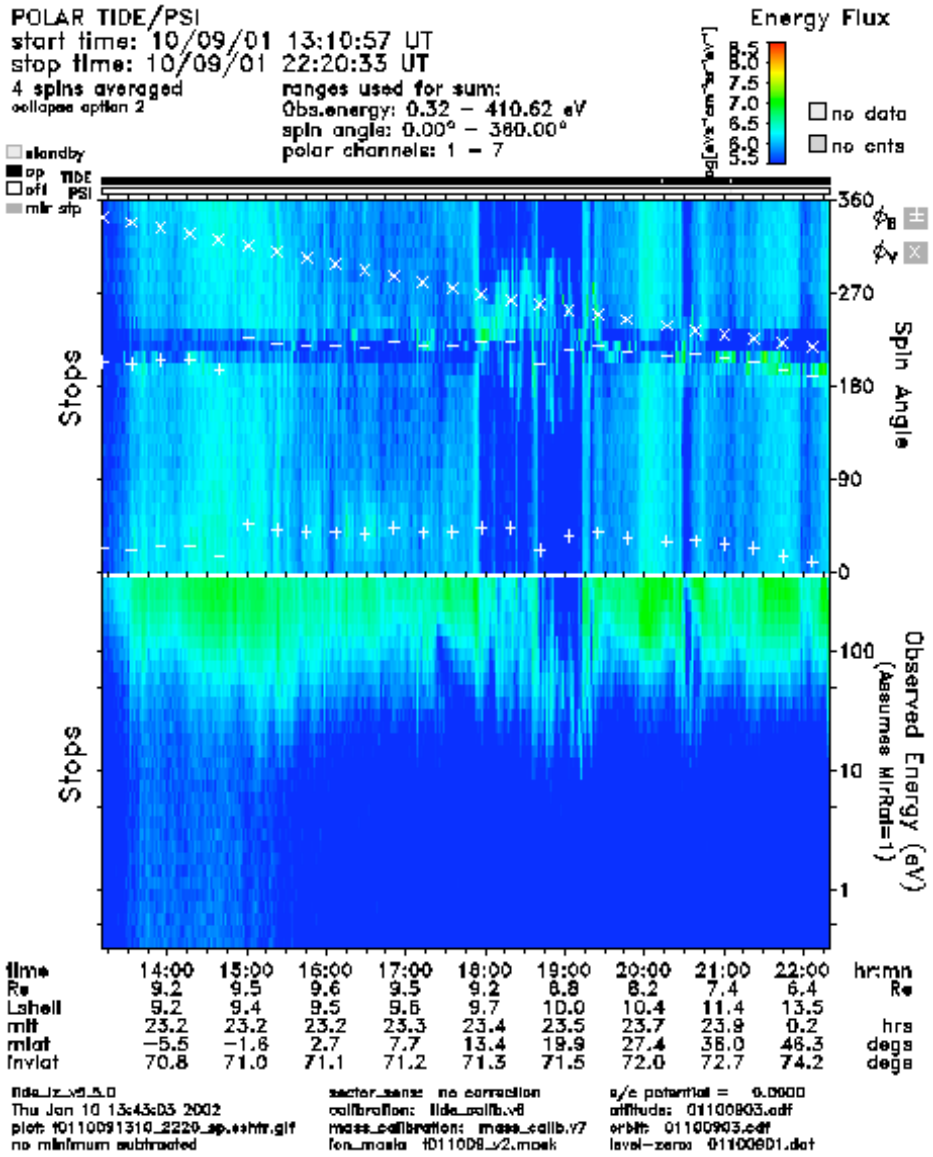
Common features:

- Bi-directional streaming across the neutral sheet
- Uni-directional streaming at higher magnetic latitudes
- Density is very small (< 0.01 cm^{-3})
- Bulk-flow energy is ~100 eV (100-200 km/s for H^+)
- Temperatures are small ($T_{\parallel}$,$T_{\perp}$ < 10 eV)

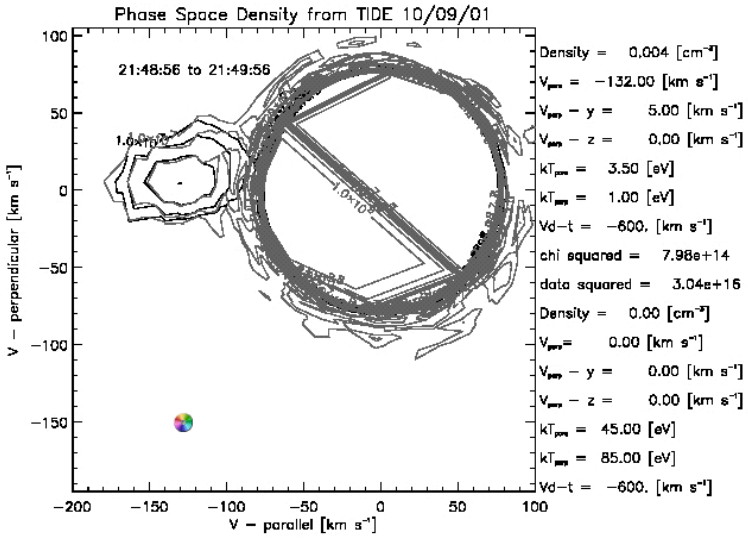
Example of a thick neutral sheet crossing (from Tom's ICS-6 talk):



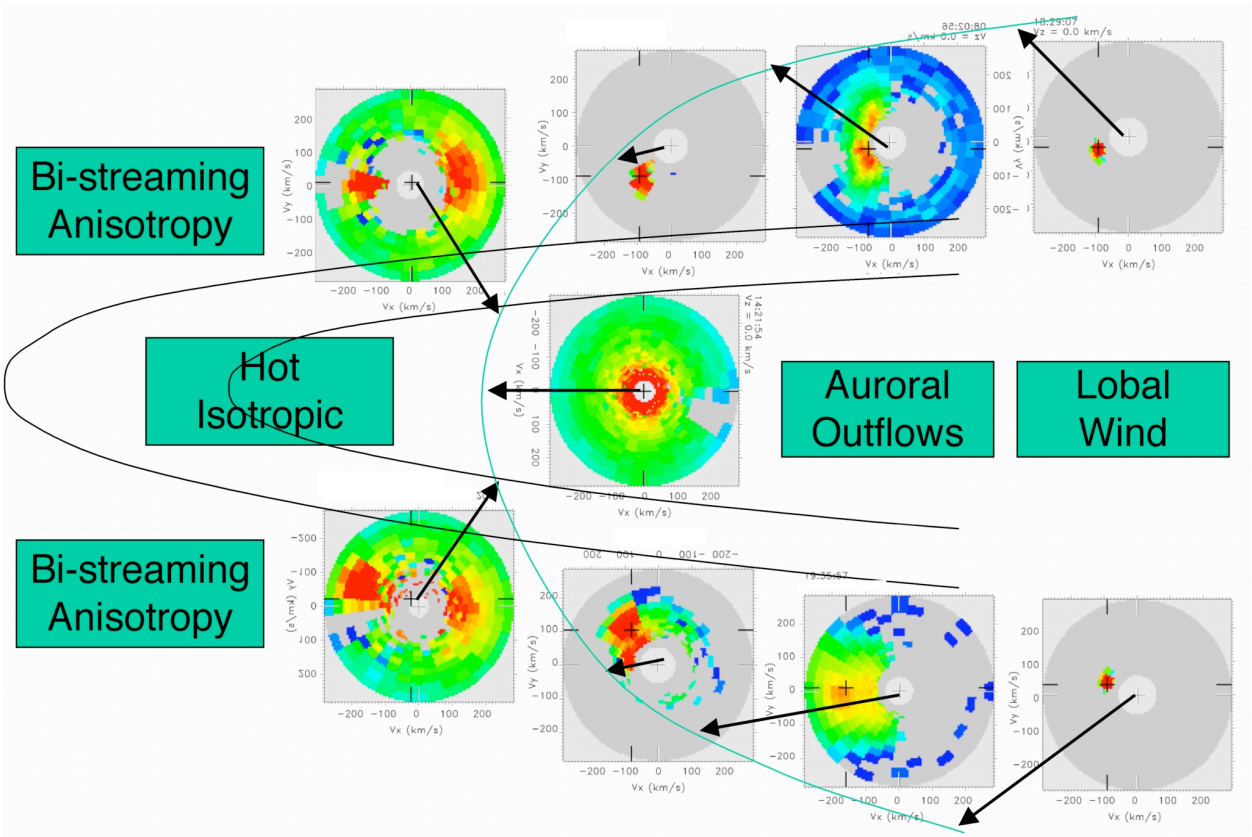
Example of a thin neutral sheet crossing (from Tom's ICS-6 talk):



Example of a phase space density plot (from Tom's ICS-6 talk):



Tom's schematic summary of the observations (from Tom's ICS-6 talk):



Survey of Lobal Winds in the TIDE Database:

So far: July 1 - September 13, 2001 (up to eclipse)
Number of half-orbits in survey: 162
MLT range in survey: 0.7 to 5.7 h

Objective: Look for lobal winds in each half-orbit (north, south)
Criteria: Small background radiation contamination (some half-orbits omitted)
Identifiable by eye in the summary plots
Half-orbit begins either:
at transition to rammed cold plasma at high latitudes
beyond the radiation belt contamination interval
Half-orbit ends at neutral sheet

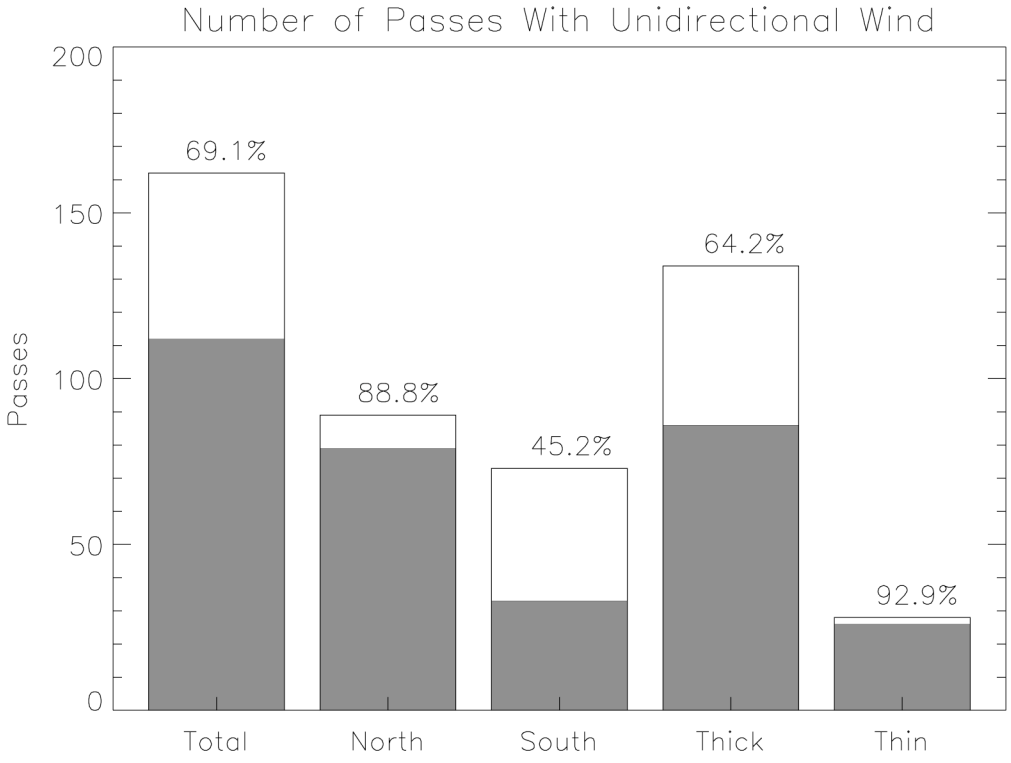
Parameters in survey database so far:

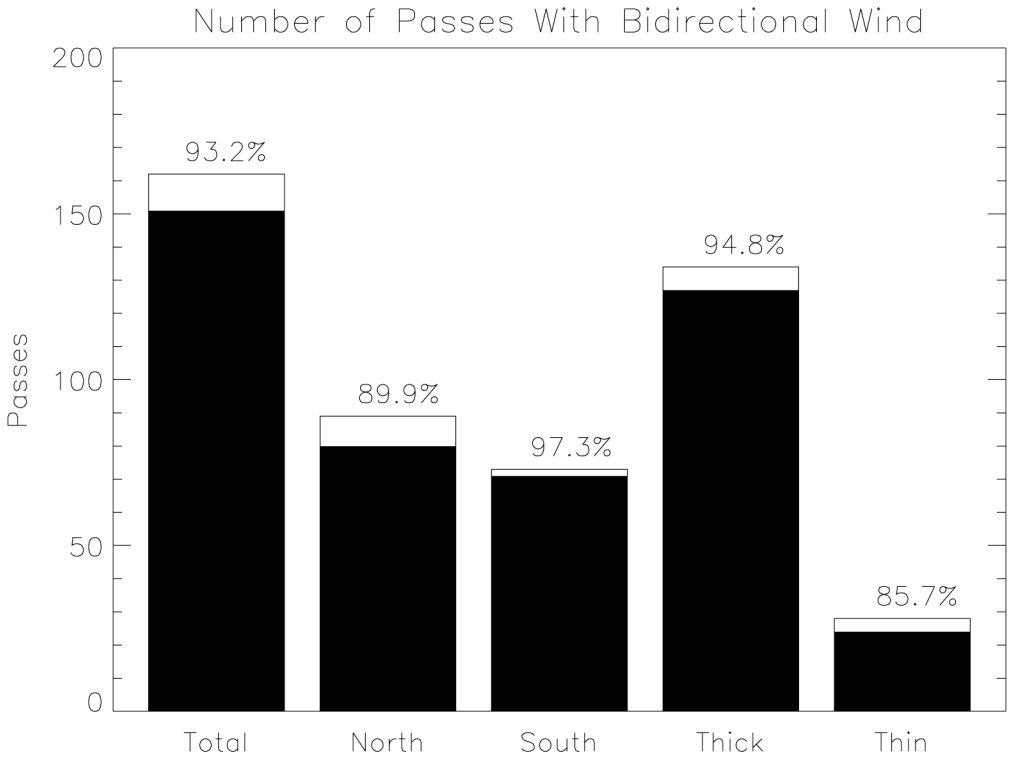
- Date, start time, stop time, and duration of the half-orbit pass
- North/south flag
- Thick/thin neutral sheet flag (thin = less than 1 hour for field to flip)
- MLT of neutral sheet endpoint of half-orbit
- Unidirectional wind flag
- Duration of unidirectional wind
- Bidirectional wind flag
- Duration of bidirectional wind
- Average Dst during half-orbit pass
- Change in Dst (start-time Dst minus stop-time Dst)
- Change in Dst per hour
- Average SW density
- Average SW velocity
- Average SW dynamic pressure
- Average IMF By
- Average IMF Bz
- Average IMF Bt (square root of $By^2 + Bz^2$)
- Average clock angle
- Average SW Ey
- Average Kan and Lee E-field

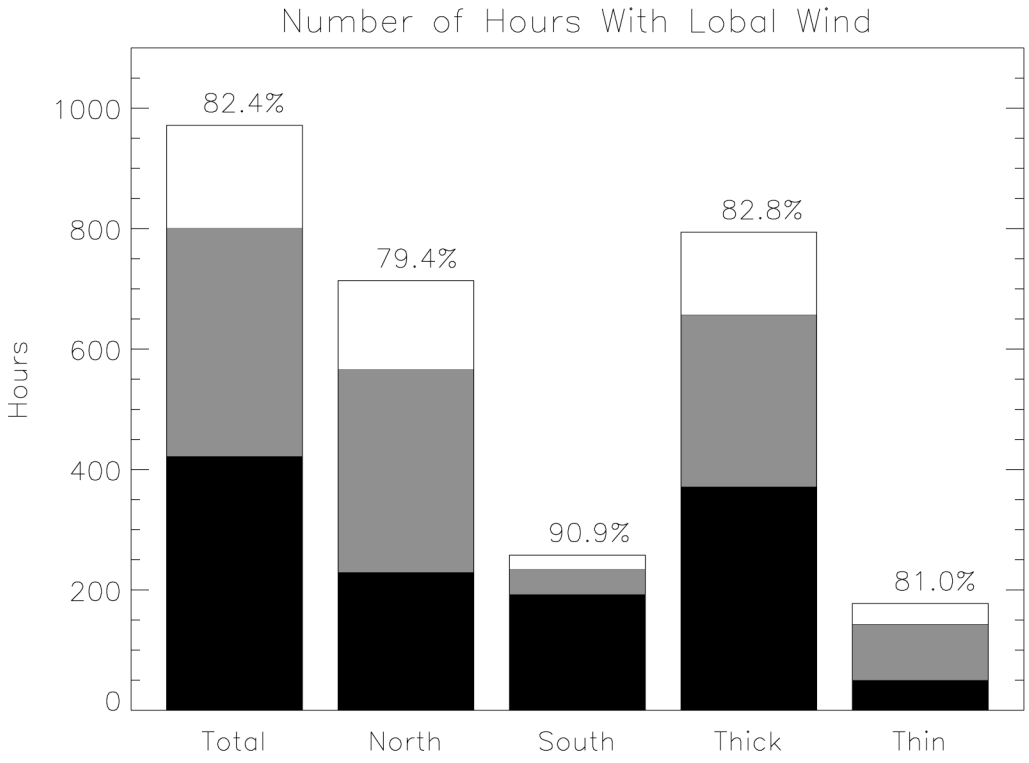
Parameters to be added:

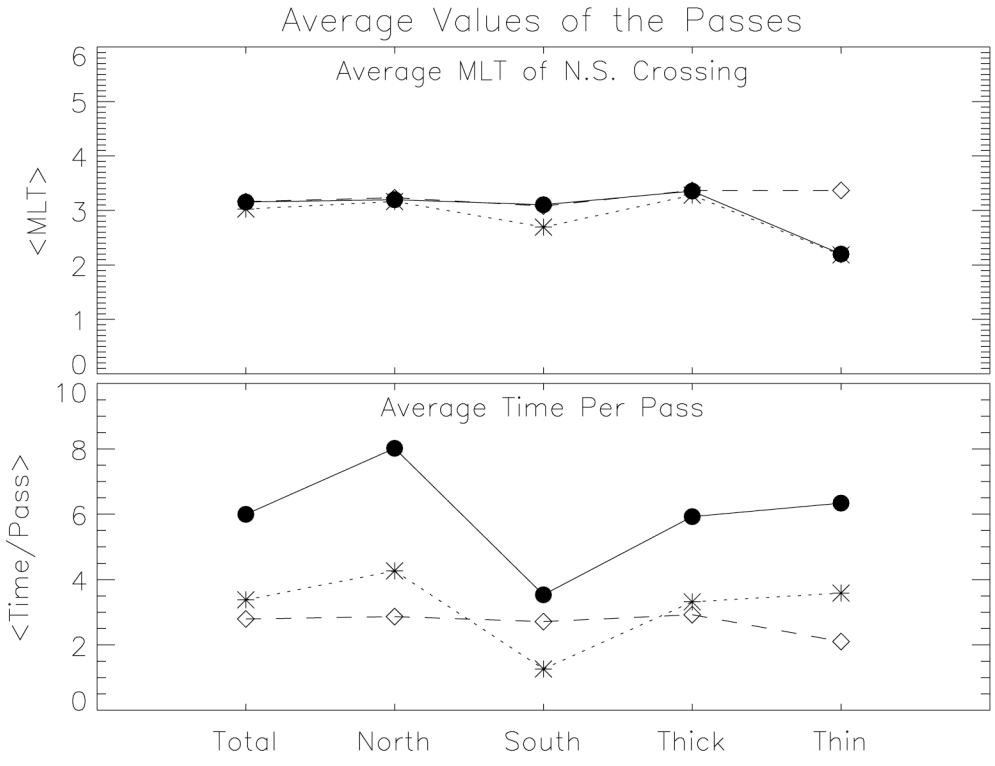
- Average AL and AE, and number of negative AL excursions
- Average density, velocity, and temperature of the lobal wind
- Geocentric distance of neutral sheet endpoint
- Latitude and distance of most poleward bi-directional wind
- Whatever you guys think I should add...

The Results So Far

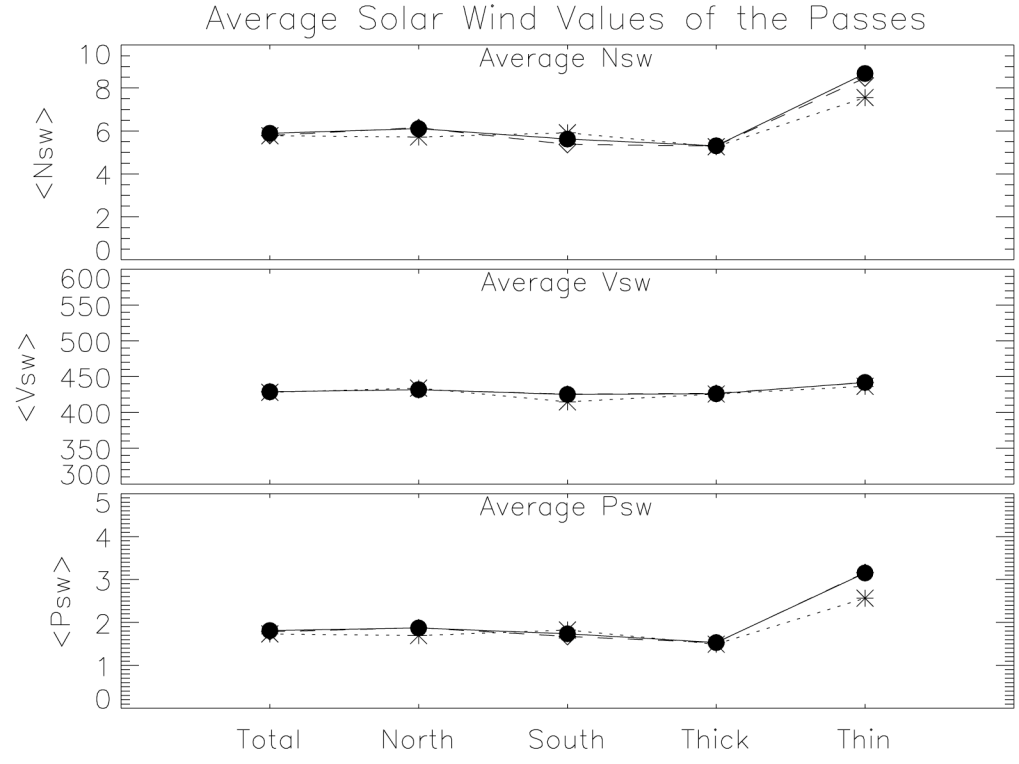


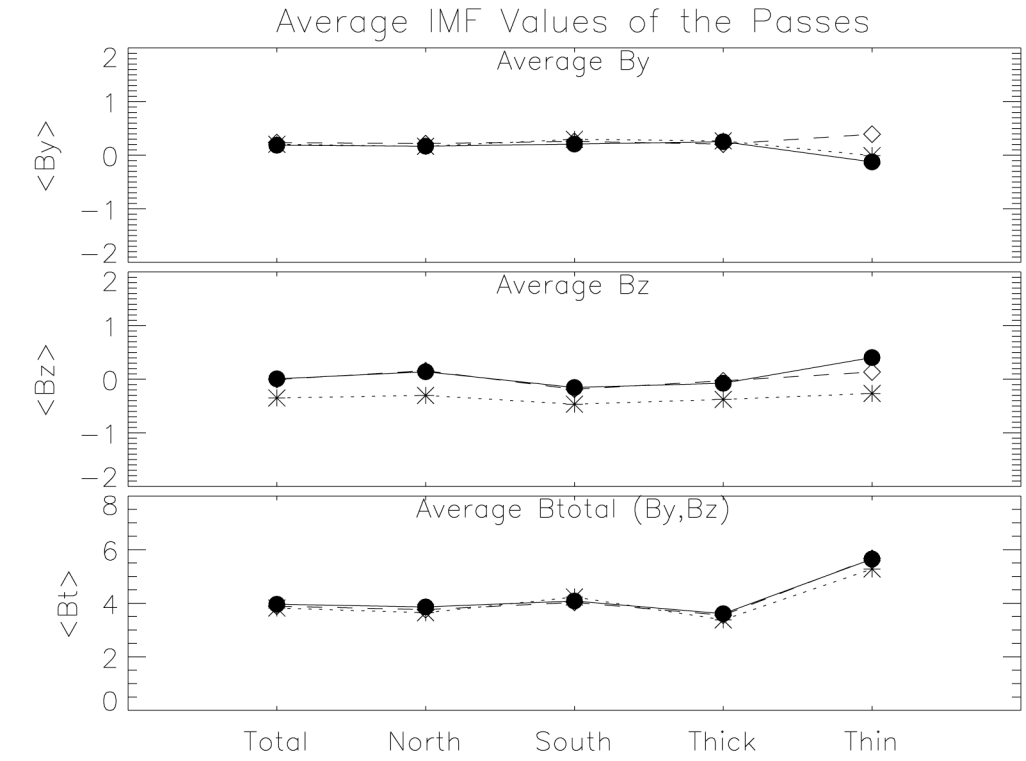


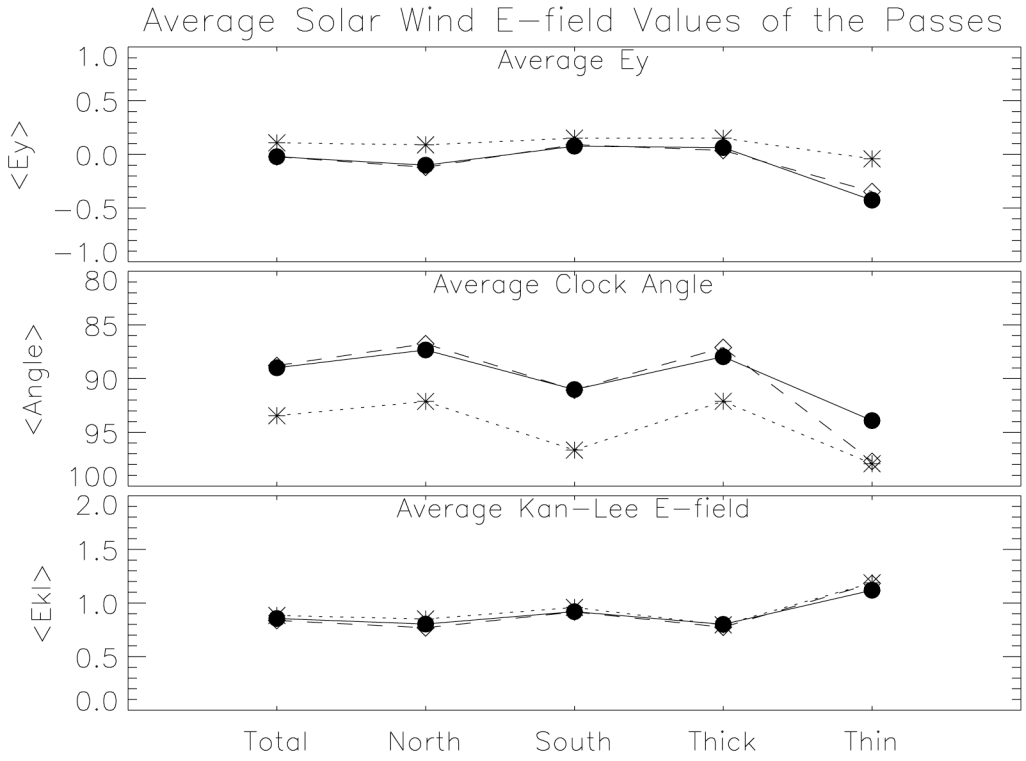

Number of Hours With Lobal Wind
Hours
1000
800
600
400
200
0
82.4%
79.4%
90.9%
82.8%
81.0%
Total
North
South
Thick
Thin


Average Values of the Passes
Average MLT of N.S. Crossing
<MLT>
6
5
4
3
2
1
0
Average Time Per Pass
<Time/Pass>
10
8
6
4
2
0
Total
North
South
Thick
Thin


Average Dst Values of the Passes
Average Dst
<Dst>
Average Change in Dst
<Delta Dst>
Average Change in Dst Per Hour
<dDst/dt>
Total
North
South
Thick
Thin


Average Solar Wind Values of the Passes
Average Nsw
<Nsw>
Average Vsw
<Vsw>
Average Psw
<Psw>
Total
North
South
Thick
Thin


Average IMF Values of the Passes
Average By
<By>
Average Bz
<Bz>
Average Btotal (By,Bz)
<Bt>
Total
North
South
Thick
Thin


Average Solar Wind E−field Values of the Passes
Average Ey
<Ey>
Average Clock Angle
<Angle>
Average Kan−Lee E−field
<Ekl>
Total
North
South
Thick
Thin

Summary

Ubiquitous is an understatement

- Every half-orbit in database contains a lobal wind measurement
- 82% of time in these half-orbits contain lobal wind measurements

Trends are explainable

- South passes are closer to Earth and at lower magnetic latitudes, so more bi-dir winds
- North has a smaller time percentage because of high-latitude portions of passes
- South has shorter average time than north because of orbit geometry
- Thin sheet times happen during negative Dst and decreasing Dst (active times)
- Thin sheet times happen during higher Nsw/Psw (pressure hits)
- Thin sheet times happen during higher Bt (but not necessarily $Bz < 0$)
- Unidir wind times happen during lower Dst for south passes (stretched field)
- Unidir wind times hapen during $Bz < 0$, clock angle > 90, $Ey > 0$ (stretched field)

Things to do:

- Look for trends with respect to MLT
- Look for trends with respect to geophysical parameter values
- Calculate moments of the lobal wind observations
    - Can we have the moments calculation track the B-field location in spin angle?
- Error bars and statistical significance analysis